

more than six years since the second supplement appeared, and in the interval the study of the kathode stream, the phenomena of radio-activity, and in general of everything concerned with the propagation of electricity in gases has given rise to a new conception of electrical conductivity, and of the ultimate constitution of what were once called the "electrical fluids." The faith of scientific men in the non-transmutability of matter has been shaken; even the notion of material mass tends to be absorbed in that of electromagnetic inertia.

This is the state of things as set forth in the preface to this supplement; no surprise need be felt, then, at its large size compared with that of the preceding numbers. The portion dealing with radiations includes amongst other things an account of recent work on the energy of a block body, the pressure of radiation, the laws of dispersion (normal and anomalous), remainder rays, and N-rays. In regard to the last-named subject, we have no wish to be dogmatic; there is certainly some evidence that M. Blondlot has been experimenting with objective, and not entirely with subjective, phenomena, and if this is so, experiments should not cease until the exact nature of these phenomena has been established. But when M. Bouty devotes nearly two pages to this subject, and does not even hint that there is doubt, amounting to disbelief, in the minds of most of the leading physicists of the world in regard to this matter, we think that he is hardly doing justice to it.

In electricity, leading sections deal with wireless telegraphy, polyphase currents, the ionic theory, and the work of Nernst. Under the head of ionisation are taken the phenomena of ionisation in gases and radio-activity. The volume concludes with some miscellaneous practical applications of electricity.

Any who are familiar with the main treatise and the previous appendices will know that M. Bouty is a master of lucid exposition; there is no need to commend this volume to them. Those who are desirous of learning, in brief but clear summary, the present state of knowledge in regard to the above supremely important subjects may be recommended to read this appendix.

(3) The third of the above books is the first volume of a course of elementary physics based on lectures delivered to classes consisting largely of medical students. As the reader is assumed to be attending experimental lectures and, if possible, performing experimental work himself in a laboratory, small space is given here to descriptions of experiments and of methods of observation.

The subjects dealt with are mechanics, and the properties of bodies in the solid, liquid, and gaseous states. The sixth chapter consists of thermodynamical considerations in respect to gases. This chapter is undoubtedly very lucid, but we think that its proper place is later on—after calorimetry. The mathematics employed is simple, and the treatment very clear. The name of the author is, of course, a sufficient guarantee of the nature of the book. We look forward to seeing the German translation of the remainder.

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REDUCTION OF GEODETIC MEASURES.

The Adjustment of Observations by the Method of Least Squares, with Applications to Geodetic Work. By T. W. Wright, with the cooperation of J. F. Hayford. Second edition. (New York: D. Van Nostrand Co.; London: A. Constable and Co., Ltd., 1906.) Price 3 dollars net, or 12s. 6d. net.

THIS is a book which in its original form grew out of the experience and requirements of the U.S. Coast and Geodetic Survey. As points of novelty or difficulty arose in the course of the work and were solved by the staff, Mr. Wright collected the decisions and the methods as guides for the treatment of similar cases in the future. The systematic arrangement of these cases, and the discussion of the principles which furnished the solution, provided a mass of material which has been of great service to the department. An opportunity has now arisen for the revision of this work, and in the belief that the information would be of advantage in many operations connected with scientific engineering, the original author, in collaboration with Mr. J. F. Hayford, chief of the computing division and inspector of geodetic work, has given to this material the form of a treatise.

The book is eminently practical. The authors do not enter into the question whether the principle of least squares suggests the best or the only method for deriving from a mass of imperfect data a result that will command general confidence. They recognise the fact that the method has secured an impregnable place in all inquiries to which it is applicable, and proceed at once to discuss the law of error on the ordinary Gauss-Chauvenet lines. The subject necessarily does not lend itself to any novelty of treatment. The value of the earlier chapters at least lies in the fact that the authors place before us the results of a wide and profound experience. Everywhere they keep in sight the practical treatment, insisting on the importance of arithmetical checks and processes of abbreviation. In this connection one is glad to see Doolittle's system of solution set out in a complete scheme, as well as other processes which have a practical application.

The question of the rejection of discordant observations will always occasion a computer some anxiety. The authors have evidently suffered, and the practical rule given here may not be generally accepted, but is valuable as showing, presumably, what is the practice in the U.S. Geodetic Survey. The authors advise that no observation should be retained for which the residual exceeds five times the probable error of a single observation, and that all observations the residuals of which exceed three and a half times the probable error of a single observation should be examined, and rejected, if any of the conditions under which the observation was made were such as to produce any lack of confidence. The conviction is also expressed that an observer's best observations are poorer than he believes them to be, and his poorest better. As a consequence of this the range of weights that observers attach to their observations is too large.

Actual geodetic measures necessarily introduce the

problem of conditioned observations, in which no set of values can be assumed to satisfy approximately the observation equations which does not exactly satisfy some *a priori* conditions. This problem may not necessitate any fresh method of treatment, but the applications are somewhat unusual, and, again, it is of very great importance to know what is done in actual practice. The authors have given us a valuable treatise, prepared with care, and generally free from errors. There is some confusion in the numbering of the figures after p. 193, but this, if annoying, is of less importance than any error in the formulæ.

W. E. P.

OUR BOOK SHELF.

Modern Milling Machines. By Joseph G. Horner. Pp. ix+304. (London: Crosby Lockwood and Son, 1906.) 12s. 6d. net.

A MODERN machine shop in any large works would be very incomplete indeed without a full complement of milling machines. The proportion of this class of machinery very largely depends upon the class of work dealt with. For instance, in a sewing-machine, cycle, or motor-car factory the milling machine would predominate, being in many specialised forms, each machine designed for some particular function. On the other hand, in a general engineering establishment any milling machines installed would be of the universal type, and capable of dealing with many different operations, such as the universal machines made by Brown and Sharpe, of U.S.A., and many others.

It is only during recent years that milling machinery has come prominently to the front, principally due to the fact that designers of such machines have grasped the fact that they must be made of ample weight with large bearing and wearing surfaces, so as to ensure steady running without spring of the machine and consequent vibration. Another very important consideration is the possibility of obtaining suitable material for the cutters used. The cost of making a milling cutter is infinitely more than the value of the cast steel used. It is evident, therefore, that when once completed the cutter should have a long life. This desideratum has been rendered possible by the introduction of high-speed tool steel, the results obtained being of a most satisfactory nature, particularly those from the "Air-hardened" steel manufactured by Edgar Allen and Co., of Sheffield. The cost of the material, therefore, is a secondary consideration.

In the volume under notice the author describes very fully many different types of machines, and probably one of the best chapters is that dealing with the design and manufacture of the cutters. The power required very largely depends on the design of cutter used, other things being equal; to use a cutter in any degree dull is also poor economy.

Another valuable assistant to the milling machine and its cutters is the introduction of special cutter grinding machines, which, I believe, emanated from the Brown and Sharpe Manufacturing Company. Many of these machines are described and illustrated, the author having gone very fully into the subject. This is as it should be, since a good cutter is of the utmost importance in milling work.

Chapter xi. is too short, though very interesting; it deals with the subject of feeds and speeds. On these constant worries of a machine-shop manager our author has much to say, and sensible advice to give, and we cordially agree with him where he

points out how easy it is to get wonderful results by means of a sharp tool running for short periods by comparison with work done under ordinary shop conditions. Such work, as a rule, does not pay.

We can recommend this volume to all interested in machine-shop practice. The machines dealt with are of the latest type, and much useful information will be found scattered through its pages.

N. J. L.

Lectures on the Method of Science. Edited by T. B. Strong, Dean of Christ Church. Pp. viii+249. (Oxford: Clarendon Press, 1906.) Price 7s. 6d. net.

THESE lectures formed part of a course on scientific method delivered at the University Extension summer meeting at Oxford last August. The discourses are intended to illustrate the forms taken by scientific method in various departments of research. Prof. Case deals with scientific method as a mental operation; Prof. Francis Gotch, F.R.S., treats of various aspects of the method; Prof. C. S. Sherrington, F.R.S., describes the scope and method of physiology; the lecture by the late Prof. Weldon discusses inheritance in animals and plants; Dr. W. McDougall explains the psychophysical method; Dr. A. H. Fison applies the method to the question of double stars, Sir Richard Temple to the evolution of currency and coinage, Prof. W. M. Flinders Petrie, F.R.S., to archaeological evidence, and the Rev. Dr. Strong to history.

From the nature of the case, the arguments are such as to appeal to persons of general culture rather than to specialists. If Oxford were as energetic in the prosecution of scientific research as she is in popularising knowledge by means of extension lectures, men of science would probably be disposed to think her activities better and more suitably directed. The omission of an index can never be justified in the case of a scientific book, but that a work devoted to scientific method should be deficient in this respect is an irony which cannot be overlooked.

The Secrets of Dog-Feeding. By "Great Dane." Pp. ix+58. (Southampton: Toogood and Sons, 1906.)

THE mere fact that this little work has reached its second edition within less than a year of the date of its first appearance may be taken as a sufficient guarantee that it has obtained the verdict of approval from dog-owners, and is therefore a success. The author is of opinion that the nature of the food is a matter of prime importance in the case of valuable, highly-bred dogs, and one which too often receives but insufficient attention on the part of their masters. While advocating a mixed diet, he deprecates the use of green vegetables, which has of late years come much into fashion among many dog-owners; and he adds that to a dog which has been kept largely upon farinaceous food the change to a meat diet in later years will often produce highly satisfactory results. The constituents of nearly all the foods referred to are given, so that readers can judge for themselves as to their nutritious value.

R. L.

In My Garden. A Little Summer Book for Nature Lovers. Pp. 72. (Wellingborough: The Laverder Press; London: Philip and Tacey, Ltd., 1906.) Price 1s. net.

THIS dainty little memorandum book, with its blank pages for notes on experiments in gardening and other observations of natural objects, will please all students of country life. The well-selected quotations and the hints on table decoration should appeal to a wide circle of readers.